

REMARKS

Claims 34, 37-39 and 45 are pending and stand rejected. The specific issues raised in the office action are addressed as follows.

As a preliminary matter, the change in the Examiner of record is noted. This is appropriately reflected in this communication.

Claims 34 and 45, are objected to as containing informalities.

The Examiner's assistance in addressing the minor informalities is appreciated. Amendments have been made to correct the informalities. Another minor change was made to an antecedent recitation that inadvertently omitted a word. These changes are do not affect the scope of the claims.

Claims 34, 37-42 and 45, stand rejected under §112, second paragraph.

The rejection is respectfully traversed. The claims would be readily understood by an artisan, as they have been understood through the previous office actions in this case. The claims were also sufficiently well-understood to apply to references in the rejection.

The Examiner states the rejection by posing questions. The questions are readily answered by reading the claims with the perspective of an artisan, demonstrating that the claims meet §112 second paragraph. "The essential inquiry pertaining to this requirement is whether the claims set out and circumscribe a particular subject matter with a reasonable degree of clarity and particularity. Definiteness of claim language must be analyzed, not in a vacuum, but in light of:

(A) The content of the particular application disclosure;

(B) The teachings of the prior art; and

(C) The claim interpretation that would be given by one possessing the ordinary level of skill in the pertinent art at the time the invention was made." MPEP §2173.02. "Applicant may use functional language, alternative expressions, negative limitations, or any style of expression or format of claim which makes clear the

boundaries of the subject matter for which protection is sought.” MPEP §2173.01.

A first question posed by the Examiner is “are the pores being etched or is there a separate code being etched?” This is not a precise question, as it is compound. In answer to the first part of the compound question, yes the claimed structure clearly includes pores that have been etched. Artisans understand that semiconductors and insulators can be etched to produce pores and the claims explicitly require a “physical multi-layer porosity structure with multiple porosity interfaces between consecutive multiple porosity layers.” In answer to the second part of the question, the claims also explicitly and unambiguously relate the physical porosity structure to the code, and no artisan would question that the porosity results from the code. The etching code, resultant porosity and the resulting optical signature are all clearly related to each other by the claim language. The claims define physical multi-layer porosity structures in detail, defining porosity interfaces and porosity layers having multiple optical thicknesses. What other meaning is possible from the following phrase: “the physical multi-layer porosity structure is configured to produce an optical signature in the form of an interference pattern in the reflectivity spectrum that uniquely corresponds to a single particular etching code,” especially when artisans appreciate that etching creates porosity and claim 34 also states that the code was “from a library of codes that was used to create the particle via a computer waveform controlled etch”? No artisan would attribute the optical signature in the interference pattern to anything other than the defined porosity structure that results from the etching code, nor is any other meaning fairly taken from either of claim 34 or 45.

A second question posed by the Examiner is “Is the optical signal the code or does the optical signal correspond to a code that has been etched?” This question is already explicitly answered in the claims. The claims defined the “*optical signature in the form of an interference pattern in the reflectivity spectrum that uniquely corresponds to a single particular etching code.*” Thus, the optical signature corresponds to an

etching code. Also, this is a matter of terminology, because a unique optical signature can, of course, be treated as a code. However, the claim clearly assigns the terminology as 1) optical signature in the form of an interference pattern in the reflectivity spectrum; that uniquely corresponds to an 2) etching code. “A fundamental principle contained in 35 U.S.C. 112, second paragraph is that applicants are their own lexicographers. They can define in the claims what they regard as their invention essentially in whatever terms they choose so long as **>any special meaning assigned to a term is clearly set forth in the specification.” MPEP §2173.01.

There is a separate basis stated regarding claim 42, in that “the thin film” in line 1 lacks a clear antecedent basis. Claim 42 has been amended to moot this rejection.

Claims 34, 37-38, 41, 42 and 45, are rejected under 35 U.S.C. § 102(b) over Cunin et al. (Biomolecular screening with encoded porous-silicon photonic crystals, 2002, Nature Materials, Vol I, pp. 39-41).

The rejection is respectfully traversed. A petition has been filed to amend this application to claim priority from prior co-pending application serial number 10/503,217, filed August 2, 2004, which claims priority PCT/US03/03040, filed January 31, 2003, which claimed priority of provisional application serial number 60/355,234, which was filed on February 7, 2002. The prior omission of the priority claim was unintentional. The publication date of the Cunin et al. publication date is September 2002, and it does not qualify as prior art upon acceptance of the amendment to add the priority claim.

Claims 34, 37-42, and 45 are rejected under 35 U.S.C. 102(e) as being anticipated by Sailor et al. (US Patent Application 2005/0042764, with priority to February 7, 2002, cited by applicants in IDS).

The rejection will be rendered moot by the amended priority claim, upon

approval of the above-mentioned provision to amend the instant application to claim priority from the co-pending application cited in this rejection.

Claims 34, 37-42, and 45 are rejected under 35 U.S.C. 103(a) as being obvious over Cunin et al. (Biomolecular screening with encoded porous-silicon photonic crystals, 2002, Nature Materials, Vol 1, pp 39-41) and Chan et al. (Nanoscale microcavities for biomedical sensor applications, 2000, Proceedings of SPIE, Vol 3912, pp 23-34).

The rejection will be rendered moot by the amended priority claim, upon approval of the above-mentioned provision to amend the instant application to claim priority from prior co-pending application serial number 10/503,217. The publication date of the Cunin et al. publication date is September 2002, and it does not qualify as prior art upon acceptance of the amendment to add the priority claim.

Claims 34, 37-39 and 45, are rejected under 35 U.S.C. § 103(a) as being unpatentable over Trau et al., U.S. Patent No. 2003/0124564, published on July 3, 2003, in view of Li et al., U.S. Patent No. 5,168,104, issued on December 1, 1992.

This rejection is respectfully traversed. All previous comments concerning Trau/Li are incorporated herein, but not all of those comments will be repeated. The Examiner's "response to arguments" will be addressed.

The Previous Arguments Addressed Structure

As a whole, the "response to arguments" indicates that the previous arguments have been misunderstood. There is no issue relating to "product-by-process" claims. All of the previous arguments relate instead to a clear issue: Trau's process cannot be modified to produce the claimed structure. The claims have a structure with "an integral and ordered physical multi-layer porosity structure with multiple porosity

interfaces between consecutive multiple porosity layers, the multiple porosity layers having multiple optical thicknesses.” These are not process steps, and response is hereby invited as to how Trau’s structure, in view of Trau’s fabrication process, could be modified to produce the claimed structure. Moreover, response is invited as to how any such modification of Trau’s structure would have been obvious given Trau’s clearly stated structure and goals in view of Li’s teachings. Applicants maintain that there is no suggestion of the claimed structure, and that there is no reasonable expectation of success or any other rational basis to conclude that Trau’s particles could be modified to have multiple porosity interfaces and layers as required by the claims.

Page 9 of the Office Action Confuses Different Portions of Trau’s Particles

Page 9 of the office action cites paragraph 0091 of Trau and emphasizes parts of that paragraph. Unfortunately, the position taken in the office action continues a previous mistake in the analysis of Trau. This mistake is the attempt to connect the optical coating (that exists as the outer shell of Trau’s particles) that Trau uses to achieve different thicknesses and scatter effects with the “varying porosity” (that exists within Trau’s particles). The following labeled illustration shows that it is the outer “optical coating” of Trau is the only feature of Trau that is used to obtain the different thicknesses in Trau’s paragraph 0091:

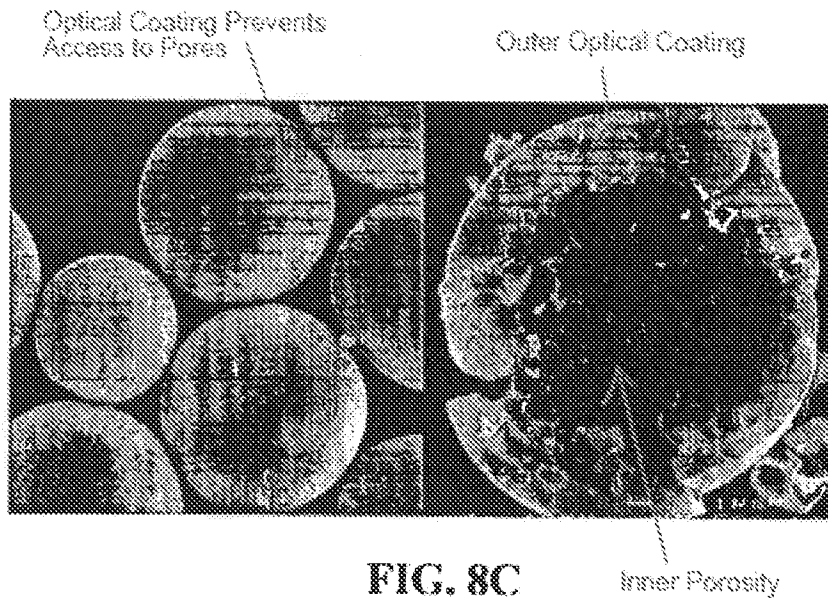


FIG. 8C

Different optical effects are achieved in Trau by variance of the outer optical coating. Trau produces thicker or thinner outer optical coatings to achieved different optica responses. This is Trau's primary method of achieving different optical effects with Trau's particles. This shell is used with the small particles that are formed by a prior art Stöber process, as described in [0088]. "In another embodiment of the invention, a particle prepared by the Stöber process is coated with a clear silica layer. In this case preferably a small particle between 0.02 and 3 microns and more preferably between 0.1 and 1 micron in diameter is prepared by the Stöber process." As noted early in Trau, the Stöber process has limits as to porosity and size. [0013].

Other methods of controlling optical response in Trau also have nothing to do with creating multiple porosity interfaces as claimed. Another of Trau's mechanisms for controlling optical response has to do with density, i.e., the pores are filled to a particular density or with a substance. "The high pore volume allows addition of a solvent or other substance of known density to the particles such that, after entering the pores, the particle density is adjusted. The density is set by incubating the particles in a given fluid, such as ethanol, methanol, propylene glycol, mercury, glycerol, and the like."

[0083].

Another of Trau's mechanisms of controlling optical response uses fluorescence tags. "Advantageously, an optical tag is added to the particles prior to coating with a silica shell. In an embodiment thereof, the optical tag is a fluor or phosphor." This, like the density control, is accomplished after formation of the particles via the chemical process.

None of these methods of controlling optical response have to do with the pores themselves, and there are clearly no layers or discussion of layers in the porous material that is the internal portion of Trau's particles. The only method of coding in Trau that has anything to do with the pores is the method involving filling the pores with another substance to achieve a density change.

Page 10 of the Office Action Incorrectly Connects Trau's Shells to Porosity

On page 10, the office action also cites paragraphs 0089-0091 to support the allegation that also "described on the particles are thin films that contribute to the porosity variation". This statement represents a clear misunderstanding of Trau and none of the highlighted statements in the office action on page 10 support this conclusion. Indeed the bolded and italicized portion of paragraph 0089 unambiguously states that it is the "different thicknesses of clear silicon shell" results in the "differing optic properties from the altered thicknesses". The paragraph continues to note that particles with a 0.1 micron shell will have a 0.7 micron final diameter and that particles with a 0.3 micron shell will have a 1.1 micron final diameter. In both examples the coatings are formed on 0.5 micron average diameter porous particles. The 0.5 micron average particles are the porous particles that become the center of the coated final particles. The outer optical coating is formed after the porous inner part of the particle already exists, and it cannot therefore affect the porosity variation, as the porosity variation results from a process that

produces the “different batches of particles” that become “coated with different thickness of clear silicon shell” as concisely described in paragraph 0089.

Pages 10 & 11 Incorrectly Connect Trau’s Variable Thickness to Trau’s Inner Porosity

The citation of paragraph 0113 in Trau repeats the above mistake. The above discussed paragraphs of Trau demonstrate that any particle size variation in Trau is achieved with the different thickness of clear silica shell. There is no dispute that Trau achieves a different size particle, but this has no relationship to the porosity that is the inner portion of Trau’s particle. In either case, Trau has a single “layer” of porosity in the center of the particle, and a second layer of non-porous clear silica shell. The only interface in Trau’s particles is between the porous central portion and the outer shell, but this does not meet or suggest the claimed features that require “an integral and ordered physical multi-layer porosity structure with multiple porosity interfaces between consecutive multiple porosity layers, the multiple porosity layers having multiple optical thicknesses.”

Nor is any process in Trau capable of producing predictable thickness variation in the particles. The basic process in Trau is a modification of the Stöber process, that involves formation of polymer chains in a two step reaction process. The “polymer precipitates out of solution as nano-sized silica particles, which are colloiddally unstable. Consequently, the particles aggregate to form larger particles.” [0011]. This process is modified by Trau to produce larger and more porous particles, but remains a colloidal polymer reaction that is not controllable in the manner presumed in the office action.

Trau’s Synthesis Offers No Opportunity to Produce Porosity Interfaces and Layers

Trau uses a chemical synthesis method, namely Acid Catalyzed Processes,

namely the “TEOS and the Stöber Process”, [0060]. Trau discloses procedures that form a hydrolysed silane emulsion and then add a cross-linker catalyst: “Organosilica particles are formed according to embodiments of the invention by a two step procedure. The first step is formation of an emulsion from mixing (a) acid, (b) water, and (c) a silane derivative to form a hydrolysed silane emulsion. The second step is to add a cross-linker catalyst to the emulsion to cross-link the silane derivative under controlled conditions to make particles of a desirable size.” [0064].

The process of Trau can control the size of particles, via control of the level of agitation during synthesis that occurs after addition of the catalyst. More agitation produces smaller particles than less agitation:

[0075] Preferably the catalyst is added while the emulsion is stirred or agitated. When synthesizing large particles, the agitation is kept to a minimum. For making small particles, particularly less than 5 microns in diameter, greater agitation is needed. For a given solution condition and temperature, the exact amount of agitation needed for a given size of particle can be determined by one skilled in the art. In one embodiment, a minimum amount of vigorous stirring is used for smaller particles. The term “vigorous stirring” in this context means increasing molecular diffusion by at least the same amount as that experienced within 300 ml of water solution in a standard 500 ml flask at 1000 rpm while stirring with a regular 1 inch long teflon coated magnet (available from Nalgene Corp. U.S.A.).

Another method of controlling particle size involves chemical reaction control with viscosity: “the formed particle size is controlled to a larger dimension by use of a non-reactive viscosity enhancer that is dissolved in the water or water co-solvent solution.” [0076]. Other ways to affect viscosity and particle size include a “water miscible solvent” and the injection of the silane emulsion into the catalyst solution. [0076].

The described process of Trau offers no opportunity to produce multiple layers having different porosities and interfaces between layers. The processes in Trau are largely unpredictable, and Trau discusses only “surprising” results for achieving

particles of particular sizes without ever stating, suggesting or implying that a particle could be created having distinct interfaces and layers. Trau admits a lack of control and lack of understanding of the formation process, and no artisan would conclude that there is any control offered or possible to achieve multiple porosity interfaces:

[0060] While studying acid catalyzed hydrolysis of TEOS and the Stober process, the inventors made several observations and discoveries for altering particle morphology in a desirable way. First, the inventors found that incorporating APS into the reaction mixture increased particle size compared to the use of pure TEOS to form particles. However, instead of acquiring a homogenous shape, the particles made of APS presented a complex internal structure and exhibited poor yield.

[0061] In response to this result, the inventors hypothesized that protonation of the amine made the monomer and any subsequent polymer more soluble, and that polymerization of the APS would occur separately from polymerization of TEOS. Silane monomers which were less water soluble than APS then were investigated. These studies revealed that MPS is a useful monomer that can form the desired particles. Based on this insight, the inventors tried increasing the concentration of MPS and discovered that optimal size and yield could be obtained when 100% of the MPS coupling agent was used. However only droplets in an emulsion formed. The inventors then used a TEOS cross-linking catalyst such as NaF to form stable particles by cross-linking the droplets. The inventors further surprisingly discovered that they could improve particle size greatly by removing the surfactant typically present in the reaction mixture. The inventors also discovered that reducing the solution pH provided higher yield of particles.

The colloidal sequencing provides “high interior” surface area, as stated in [0062]. The exact mechanism for how the sequencing proceeds is not well understood, as stated in paragraph [0071]:

[0071] Most preferably, the emulsion lacks an added surfactant, as it was discovered that omitting a surfactant led to increased particle size. Without wishing to be bound by any one theory of this embodiment of the invention, we believe that when surfactant is present, the surfactant adsorbs to the surface of the droplets and forms a monolayer between the silica and aqueous bulk of the reaction mixture. When a cross-linking catalyst is added to the emulsion, the surfactant interferes with the catalyst reaching the silica in the droplet. Thus, surfactant may be added to control the particle size.

Trau claims to increase porosity and particle size over prior Stöber processes, but there is no description, reasonable expectation of success or even the slightest hint of any method by which multiple porosity interfaces, layers of different optical thicknesses, or multiple layers could be produced in a particle produced by the colloid formation processes.

The “varying porosity” in Trau is clearly a random variation of pore and channel size that results from the not very well understood or not very predictable process of Trau. Trau’s particles include a range of pore sizes that are linked by channels, but there is no disclosure of interfaces, layers, or the ability to control where the pores and channels form “Desirably, the particles contain pores between approximately 0.1 and 5 microns in mean diameter, wherein at least two of the pores are linked by channels less than 75 nanometers in mean diameter.” [0019]. “The term ‘porous’ refers to a structure having pores between approximately 0.1 and 5 microns in mean diameter, wherein the pores may be linked by small channels less than about 200 nm, preferably less than 100 nm, and more preferably about 75 nm in diameter.” [0036].

No Library Coding is Possible with Trau’s Particles.

The varying porosity in the claims corresponds to “a single particular etching [[a]] code from a library of codes that was used to create the particle via a computer waveform controlled etch.” This is not a product-by-process limitation, but instead an external reference that can be used to define structure, i.e., the porosity in the

particle can be matched uniquely to an etching code from a library of codes. No such “library” method is possible with Trau’s particles, contrary to statements in the office action.

There is no way to measure any correspondence between porosity in one of Trau’s particles to a unique etch code, because Trau’s formation process do not involve etching and do not permit a similar level of control or predictability that would produce the requisite uniqueness. Trau forms particles by a polymer synthesis that does not permit a formed particles’ porosity to be matched to any code from a library of codes, be it any etching code or another type of code.

Trau’s process for forming porous particles is unpredictable Trau characterizes changes in particle sizes as a result of omitting surfactants as “surprising”. [0061]. No artisan would believe that a computer could aid or control the polymerization process to form libraries based upon differing porosities between particles in Trau, and there is certainly no basis to conclude that a polymerization process as in Trau could be modified to produce multiple porosity interfaces or multiple layers. Particles of the invention can produce complex codes, that can be resolved from a signal particles. Such coding is not available from Trau, which is precisely why Trau relies upon other mechanisms of filling pores, adding tags, and adding coatings.

The Proposed Modification Based upon Li has No Reasonable Expectation of Success

Li is relied upon to modify Trau and rejected claims 37-39. For the sole purpose of answering the rejection, the characterization of Li will be assumed correct. The stated reasonable expectation of success is as follows on page 11: “that the chemical attachment of the ligand binding agent results in the agent residing in the pore.” This misses a fundamental issue and limitation of Trau’s particles, namely, that the clear shell blocks access to the pores. There might be a point in functionalizing the outer shell of

Trau's particles, but there is certainly no point in functionalizing the pores as contemplated in the rejection. The previous illustration is repeated here for emphasis, as the pores or Trau are clearly blocked by the outer shell.

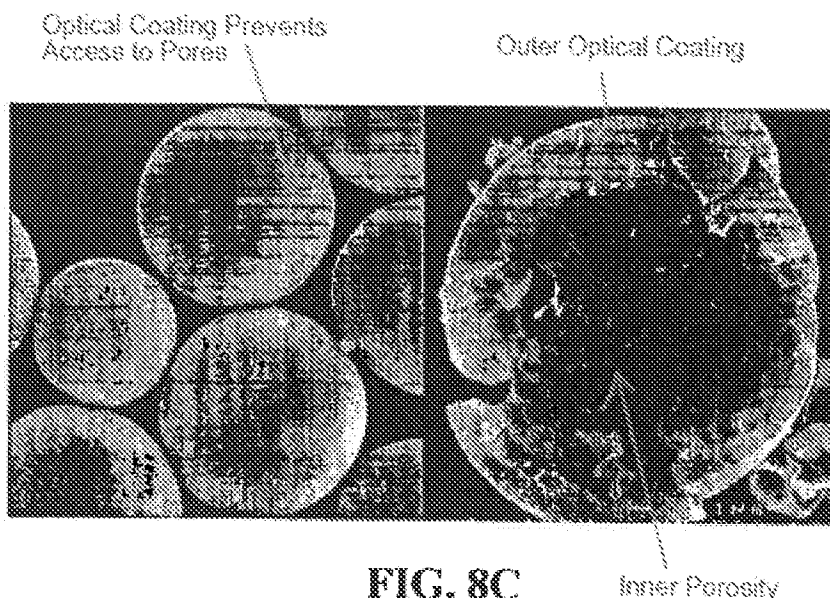


FIG. 8C

Other embodiments in Trau discussed above involve filling the pores to change density. Here again, there is no opportunity to functionalize the pores. In sum, Trau's pores are blocked and only the outer surfaces of Trau provide any opportunity for functionalization.

New Claims 46 and 47 are Separately Patentable

These new claims further define the structure of preferred embodiments, which provide distinct planar layers. Trau's particles and their formation process are not capable of such planar layers. Optical interrogation that is offered by particles of the invention is aided by the multi-layer structure with the planar surface, by providing a flat surface that results in a clearly defined angle of excitation and sensing. Trau is only capable of producing rounded particles, and is further incapable of producing multiple porosity interfaces of any type as discussed above. Even if that failure of teaching were

ignored, no planar interrogation interface is possible. As seen above, even the interface between the clear silica shell and the inner porous center is not planar.

For all of the above reasons, applicants request reconsideration and allowance of the application. Should the examiner believe that outstanding issues exist or that a conference would expedite prosecution, the examiner is invited to contact the undersigned attorney at the below listed number.

Respectfully submitted,

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